2600.025

Report

LNAPL subsurface investigation John F. Queeny Plant

Monsanto Company
St. Louis, Missouri

June 1994

O'BRIEN & GERE ENGINEERS, INC.
5000 Cedar Plaza Parkway, Suite 211
St. Louis, Missouri 63128

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Summary

O'Brien & Gere Engineers, Inc. has completed a subsurface investigation of free phase and dissolved light non-aqueous phase liquids (LNAPLs) within a former production area at the John F. Queeny Plant in St. Louis, Missouri. This report summarizes the investigative efforts which preceded and led to the LNAPL investigation, documents the procedures and analytical results of the LNAPL investigation, and illustrates the apparent extent of free phase LNAPL and affected ground water.

Ground water samples were collected during the LNAPL investigation using GEOPROBE® sampling techniques. Previously, subsurface investigations included ground water sampling via existing wells and using GEOPROBE® techniques; soil sampling by conventional hollow stem auger techniques and GEOPROBE® techniques; cone penetrometer testing; piezometer installation; and, a ground water elevation survey.

Based on the results of the LNAPL investigation, the boundary of free phase LNAPL appears to have been defined and is confined within the investigation area.

1. Objective

A subsurface investigation of light non-aqueous phase liquids (LNAPLs) was completed by O'Brien & Gere Engineers, Inc. in a former production area at the Monsanto Company (Monsanto) John F. Queeny Plant in St. Louis, Missouri. The investigation became necessary based on observations during previous subsurface investigations of volatile organic compounds (VOCs), primarily the dense non-aqueous phase liquids (DNAPLs) tetrachloroethene (PCE) and trichloroethene (TCE). The following sections present a summary of the project location, pertinent background information, and scope of this report.

1.1. Site location and description

The Monsanto John F. Queeny Plant is located in St. Louis, Missouri, just west of the Mississippi River in the southeast portion of the city at 1700 South Second Street. A topographic site location map is included as Figure 1. The investigation area for this project consists of concrete, asphalt, and chat lots where production facilities were once constructed and operated. Most of the facilities in the area have been dismantled and removed from the property. The area is located between Dekalb and South Third Streets and between Russell and Lesperance Avenues (See Figure 2.).

1.2. Background

In May 1993, Monsanto retained O'Brien & Gere Engineers, Inc. to investigate ground water and soil quality in the area of former Building FF, which had been dismantled in 1992, to assess the effectiveness of previous remediation efforts at the site. An underground storage tank (UST) containing PCE was formerly located on the northwest side of Building FF. Monsanto had

previously installed four recovery wells to recover free phase PCE from the UST, which had been determined to be leaking.

From May through November of 1993, O'Brien & Gere Engineers, Inc. completed two phases of investigation at the site. Ground water samples were collected from existing recovery and monitoring wells and using GEOPROBE® sampling methods. Soil samples were collected using GEOPROBE® sampling methods and conventional hollow stem auger techniques. Ground water and soil samples were analyzed for PCE and TCE.

During the Phase II investigation, O'Brien & Gere Engineers, Inc. observed a phase separation in one of the GEOPROBE® samples, suggesting that an LNAPL may be present. Analysis of this sample for VOCs indicated a high toluene concentration.

At the completion of the Phase II investigation, O'Brien & Gere Engineers, Inc. was unable to identify the extent of affected ground water and soil at the site. Therefore, O'Brien & Gere Engineers, Inc. proposed additional subsurface investigations at the site to assess the presence and extent of LNAPL and DNAPL at the site. The proposed investigations included collecting additional ground water and soil quality data and assessing the topography of bedrock in the area, ground water flow direction across the site, and soil conditions.

O'Brien & Gere Engineers, Inc. completed a series of cone penetrometer tests (CPTs) to assess the depth to bedrock beneath the site. Based on the results of the CPTs, a network of piezometers was installed across the site. O'Brien & Gere Engineers, Inc. then completed a ground water elevation survey and ground water sampling event.

During the survey and sampling event, a layer of free phase LNAPL was observed in one of the piezometers. Therefore, Monsanto and O'Brien & Gere Engineers, Inc. initiated additional subsurface investigations to assess the limits of the free phase LNAPL and the associated affected ground water.

1.3. Scope of report

This report summarizes the subsurface investigation of the extent of LNAPL within the specified investigation area at the Monsanto John F. Queeny Plant. The report presents a summary of pertinent analytical results from investigations preceding the LNAPL investigation; a summary of the methods used during the LNAPL investigation; and, a summary of the analytical results of the LNAPL investigation. Also included in the report are an estimated ground water elevation contour diagram and an estimated ground water concentration contour diagram which depicts the approximate areal extent of the free phase plume and estimated VOC concentrations in ground water at the site.

2. Field investigation

The following sections present a summary of previous and current field investigations and analytical results related to the LNAPL investigation for this project. Descriptions of the methods used and quality assurance/quality control procedures employed are also provided.

2.1. Previous investigation

In December 1993, O'Brien & Gere Engineers, Inc. retained Fugro Geosciences, Inc. to complete CPTs and piezometer installations at the Monsanto John F. Queeny Plant. Twelve CPTs were completed and eight ¾-inch diameter stainless steel piezometers were installed at the site. A nest of three piezometers (PZ-7A, PZ-7B, and PZ-7C) was installed in the vicinity of the GEOPROBE® sample in which evidence of LNAPL was observed during the Phase II investigation. The piezometers were each screened over a different interval to permit investigation of LNAPL and DNAPL constituents. During subsequent ground water elevation surveys completed by O'Brien & Gere Engineers, Inc. in February and March of 1994, a free phase layer of LNAPL was observed in piezometer PZ-7B. The approximate thickness of this layer was measured to be 10.75 ft. Ground water samples were collected on March 14, 1994 from piezometers PZ-2, PZ-5, PZ-7C (screened below the observed LNAPL layer in PZ-7B), and PZ-12 (See Figure 2.). The samples were submitted to Savannah Laboratories and Environmental Services, Inc. for volatile organic compounds (VOCs) analysis. Positive results of the analyses are summarized in Table 2-1.

Table 2-1. ***Summary of positive analytical results (in µg/L) from the March 1994 sampling event***

	Sample ID				
Parameter	**PZ-2**	**PZ-5**	**PZ-7C**	**PZ-7CD**	**PZ-12**
Vinyl Chloride	ND	ND	22,000	19,000	ND
Methylene Chloride	430	80	8,900	9,300	38
Cis-1,2-Dichloroethene	ND	ND	110,000	99,000	ND
Toluene	2,100	610	27,000	27,000	670
Chlorobenzene	ND	660	16,000	16,000	ND
Ethylbenzene	ND	1,100	ND	ND	ND
Xylenes	1,300	2,000	ND	ND	ND

ND - Not detected above method detection limit
Source: O'Brien & Gere Engineers, Inc.

Estimated ground water elevation contours, based upon water level measurements collected in March 1994, are depicted on Figure 3.

2.2. GEOPROBE® ground water investigation

Based on the results of the March 14, 1994 sampling event, an additional ground water investigation was completed in May 1994 to assess the areal extent of the free phase LNAPL and affected ground water. O'Brien & Gere Engineers, Inc. retained GeoTrace, Inc. to provide ground water sampling services at the site. Eight ground water samples were collected using GEOPROBE® sampling methods. The sampling locations are depicted on Figure 2.

The GEOPROBE® technique involved hydraulically driving a slotted probe into the subsurface until ground water was detected inside the probe. A ground water sample was then collected from the probe using polyethylene tubing and a ball valve assembly and visually inspected for the presence of LNAPL. The ground water samples were analyzed using a field gas chromatograph (GC). Each sample was prepared for analysis by transferring approximately 20 mL of the sample into a 40 mL vial which was then sealed and placed in a block heater. Following approximately twenty minutes of heating, a headspace sample was drawn out of the vial and injected into the field GC for analysis for the following compounds: vinyl chloride,

methylene chloride, cis-1,2-dichloroethene, trichloroethene, toluene, tetrachloroethene, chlorobenzene, ethylbenzene, and xylenes.

Originally, GPT-3 was probed to a depth of 18 ft below grade and a sample was collected. However, O'Brien & Gere Engineers, Inc. and GeoTrace, Inc. suspected that the sample may have been collected from a shallow perched lens. Therefore, following sample collection at the 18-ft probe depth, the probe was advanced to a depth of 21 ft below grade and a second sample, GPT-3A, was collected.

During the ground water sampling, free phase LNAPL was detected in the probe at sample location GPT-5, which is approximately eight feet north and twenty-nine feet west of PZ-7B. A sample was not collected from this probe. Instead, probes were advanced in sampling locations GPT-7 and GPT-8, west and north of GPT-5, respectively, to further assess the limits of the free phase plume. Free phase LNAPL was not encountered in the probes at either of these locations and, thus, samples were collected from GPT-7 and GPT-8.

In an attempt to assess whether the organics had migrated into the sewers in the site vicinity, a gas sample was collected from a storm sewer manhole located to the east of GPT-7. The gas sample was injected into the field GC for analysis for the compounds listed above.

During the GEOPROBE® sampling event, personnel monitoring and environmental monitoring were conducted by O'Brien & Gere Engineers, Inc. Personnel were monitored for heat stress at approximate 2-hour intervals (excluding the lunch period). Heat stress monitoring consisted of measuring the pulse rate and oral temperature of O'Brien & Gere Engineers, Inc. and GeoTrace, Inc. personnel on site. The probe holes were screened using an explosimeter and a photoionization detector equipped with an 11.7 eV lamp.

2.3. Quality assurance/quality control

Duplicate samples were collected by GeoTrace, Inc. during each day of sampling. Duplicate samples were handled and analyzed using the procedures described above. Positive analytical results for the duplicate samples are summarized in Table 2-2. The duplicate sample results agreed with the respective field sample results.

In addition, a split sample was collected by O'Brien & Gere Engineers, Inc. and submitted to Savannah Laboratories and Environmental Services, Inc. for VOC analysis by USEPA SW846 Standard Method 8240. The split sample was shipped to the laboratory along with a travel blank. The positive analytical results for the split sample are summarized in Table 2-2. The split sample results agreed with the respective field sample result. Analytes were not detected in the travel blank, indicating that constituents were not introduced during handling and shipping.

2.4. Analytical results

Positive analytical results for the samples collected during the GEOPROBE® sampling event on May 16 and 17, 1994 are summarized in Table 2-2. The maximum toluene concentrations detected in the field ground water samples, 104,000 parts per billion (104 parts per million) and 97,000 parts per billion (97 parts per million), were detected in samples GPT-4 and GPT-6, respectively. The split sample from GPT-6 (GPT-6D) contained 130,000 parts per billion (130 parts per million). GPT-4 was located approximately forty-four feet south of PZ-7B. GPT-6 was located approximately thirty-three feet north and fifteen feet east of PZ-7B.

The analytical results appear to confirm the suspicion that a shallow perched ground water lens is present at the GPT-3 sample location. Concentrations of various VOCs increased significantly from the 18 ft depth to the 21 ft depth, as indicated in Table 2-2.

Analysis of the gas sample collected from a storm sewer manhole located within the investigation area did not reveal VOC constituents present at concentrations above method detection limits.

Based on these analytical results and knowledge of pre-existing conditions at the piezometer locations (as documented by the March 1994 sampling event), the ground water concentration contours depicted on Figure 4 were estimated. The areal extent of the free phase plume appears to be contained within the boundary shown on Figure 4.

Table 2-2. ***Summary of positive analytical results (in ppb) from the May 1994 sampling event***

	Sample ID					
Parameter	**GPT-1**	**GPT-1(d)***	**GPT-2**	**GPT-3**	**GPT-3A**	**GPT-4**
Vinyl Chloride	15	20	390	81	60	1,500
Cis-1,2-Dichloroethene	ND	ND	560	ND	ND	90,000
Trichloroethene	ND	ND	ND	ND	1,100	980
Toluene	ND	ND	43,000	23	70,000	104,000
Tetrachloroethene	ND	ND	ND	ND	1,400	6,500
Chlorobenzene	ND	ND	50,000	540	9,800	1,500
Xylenes	ND	ND	ND	ND	ND	ND

	Sample ID					
Parameter	**GPT-5**	**GPT-6**	**GPT-6D****	**GPT-7**	**GPT-8**	**GPT-8(d)***
Vinyl Chloride	NA	1,200	ND	24	7,300	7,200
Cis-1,2-Dichloroethene	NA	29,000	92,000	47	14,000	12,000
Trichloroethene	NA	180	ND	ND	ND	ND
Toluene	NA	97,000	130,000	5,200	1,400	1,400
Tetrachloroethene	NA	2,000	ND	ND	21	17
Chlorobenzene	NA	IDSE	ND	2,200	950	890
Xylenes	NA	IDSE	ND	18	ND	12

*Field duplicate sample analyzed by GeoTrace, Inc.
**Split sample submitted to Savannah Laboratories and Environmental Services, Inc.
ND - Not detected above method detection limit
NA - Not analyzed.
IDSE - Integrator data storage error - not data available

3. Conclusions

During investigations completed by O'Brien & Gere Engineers, Inc. at the Monsanto John F. Queeny Plant, a layer of free phase LNAPL was discovered. Subsequent investigations were conducted to assess the extent of the free phase LNAPL and the associated affected ground water. Based on the subsequent investigations, O'Brien & Gere Engineers, Inc. believes the free phase plume is contained within the approximate boundary shown on Figure 4.

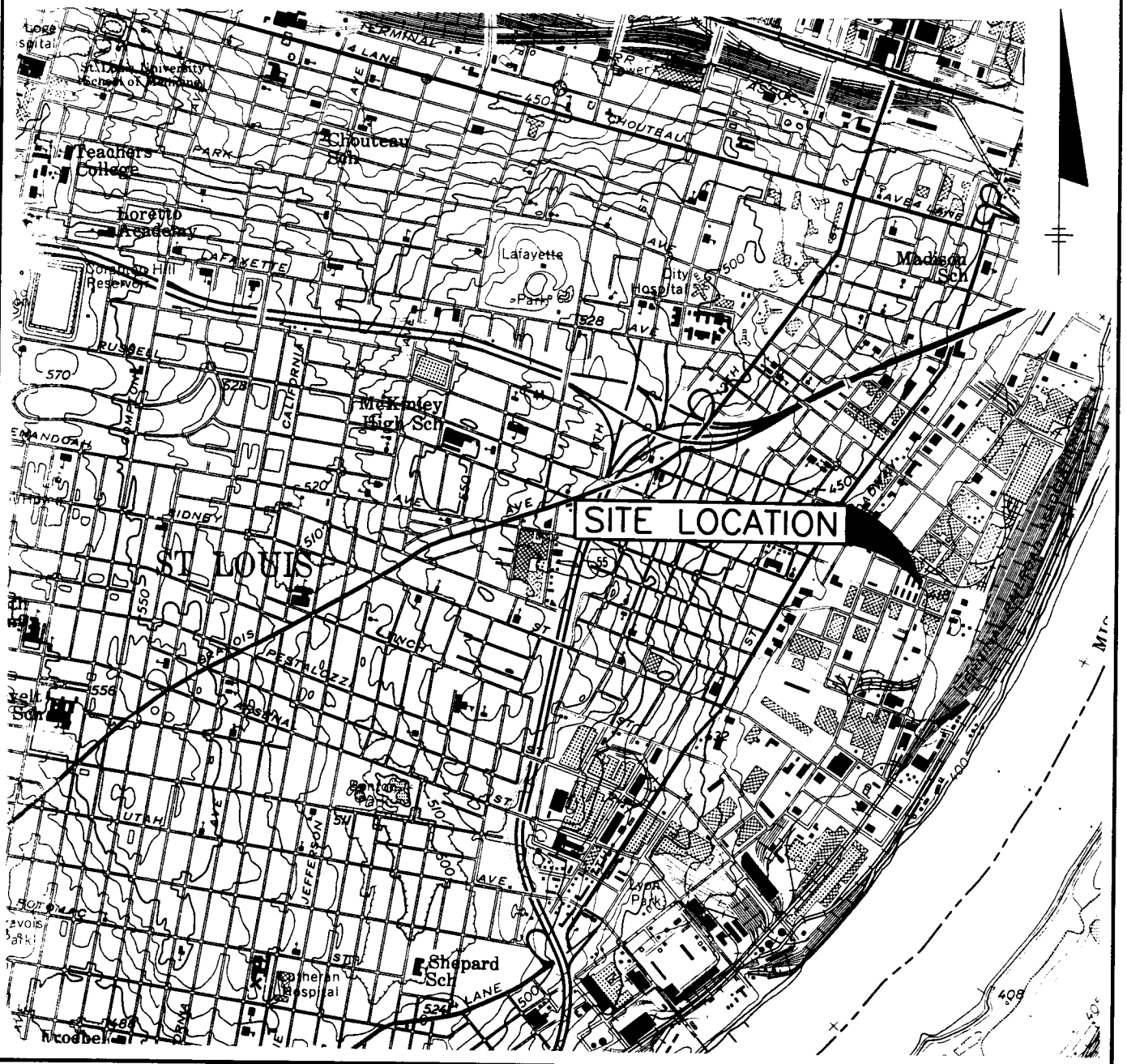
Respectfully submitted,

Dean L. Palmer, P.E.
Vice President

Prepared by:

Julie J. Lowe, P.E.
Project Engineer

FIGURE 1



MONSANTO COMPANY
JOHN F. QUEENY PLANT
ST. LOUIS, MISSOURI
LNAPL SUBSURFACE INVESTIGATION
TOPOGRAPHIC SITE LOCATION MAP

ADAPTED FROM U.S.G.S. (7.5 MIN)
CAHOKIA QUADRANGLE
CONTOUR INTERVAL 10 FEET

1" =2000' 2000 0 2000

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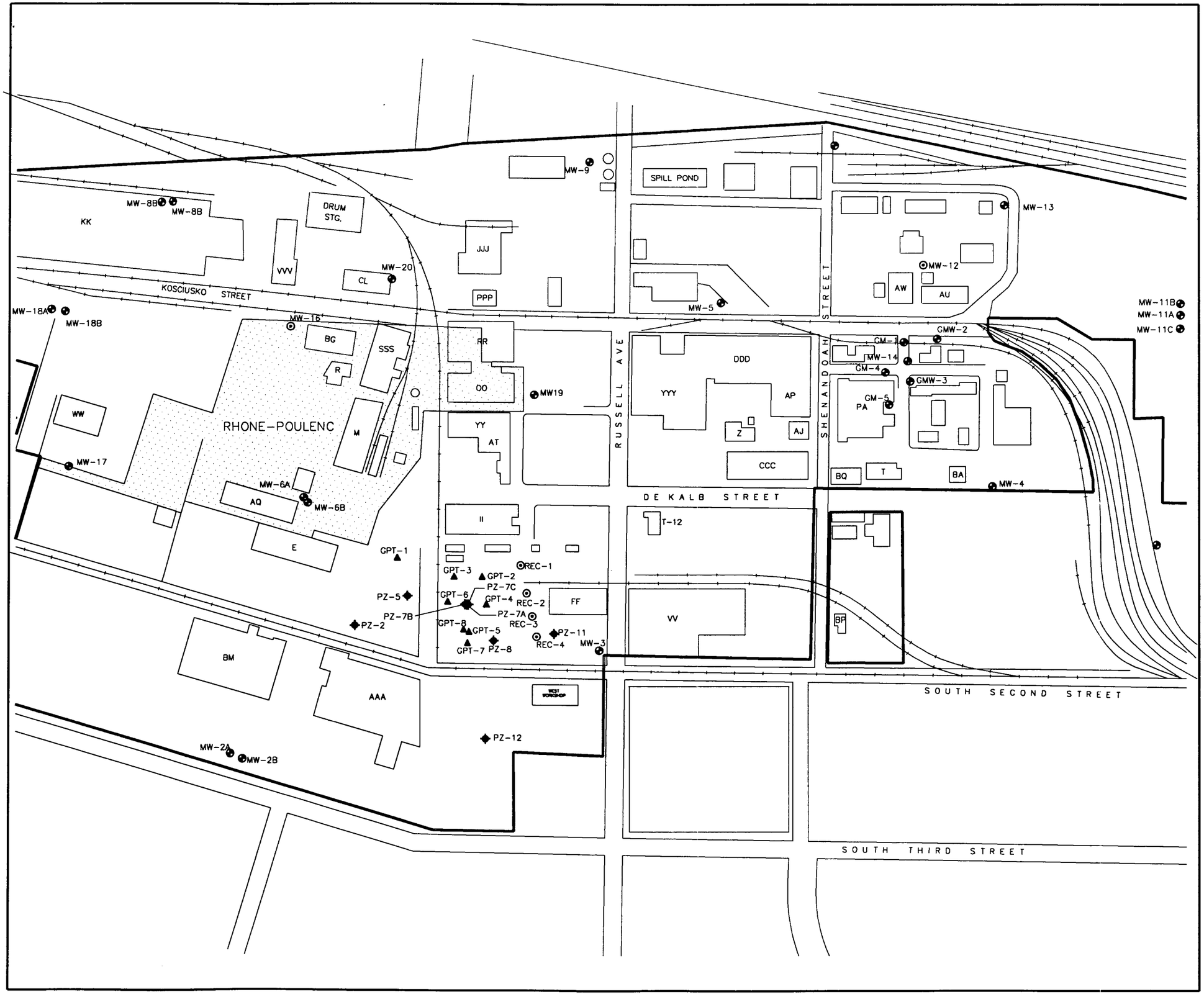
O'BRIEN & GERE ENGINEERS, INC.

FIGURE 2



LEGEND

- ▲ GEOPROBE SAMPLE LOCATION
- ⊙ RECOVERY WELL LOCATION
- ◆ PIEZOMETER LOCATION
- ⊕ GROUND WATER MONITORING WELL LOCATION

MONSANTO COMPANY
JOHN F. QUEENY PLANT
LNAPL SUBSURFACE INVESTIGATION
SITE PLAN

1" = 200'-0"

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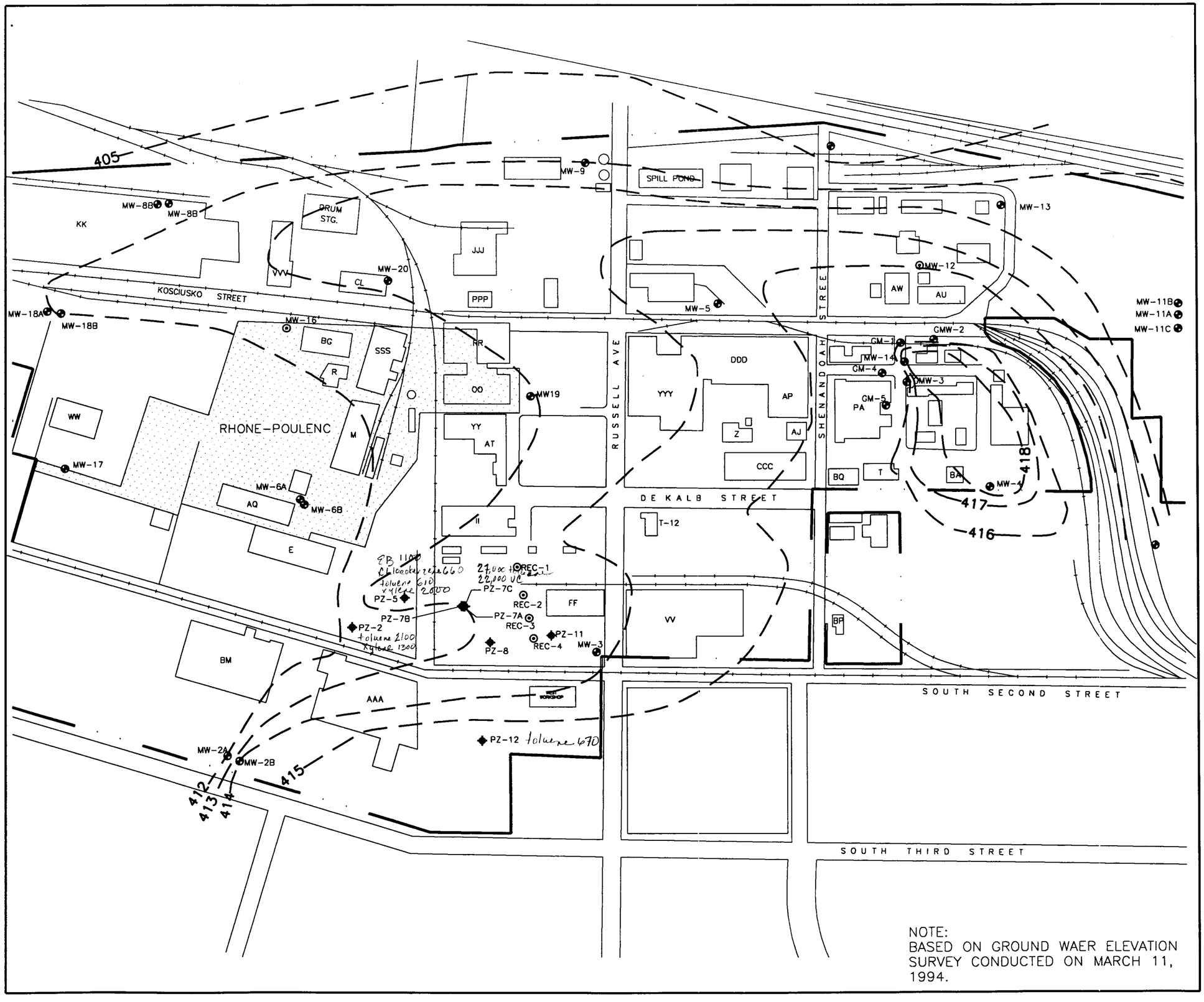
FIGURE 3



NOTE:
BASED ON GROUND WAER ELEVATION SURVEY CONDUCTED ON MARCH 11, 1994.

LEGEND

- GROUND WATER ELEVATION CONTOUR
- RECOVERY WELL LOCATION
- PIEZOMETER LOCATION
- GROUND WATER MONITORING WELL LOCATION

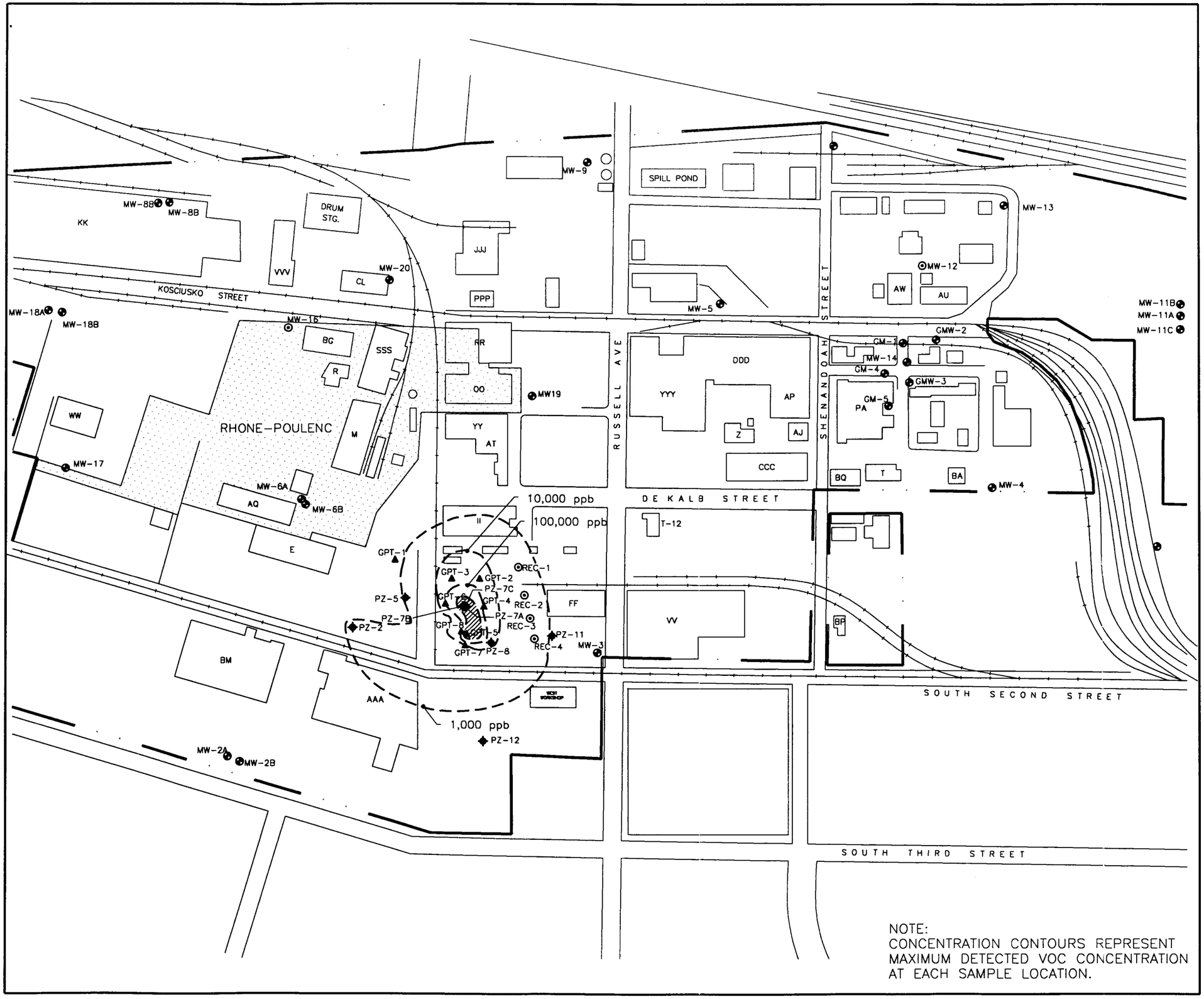
MONSANTO COMPANY
JOHN F. QUEENY PLANT
LNAPL SUBSURFACE INVESTIGATION
ESTIMATED GROUND WATER ELEVATION CONTOUR

1" = 200'-0"

FILE NO. 2600.025-05F

O'BRIEN & GERE ENGINEERS, INC.

FIGURE 4



NOTE:
CONCENTRATION CONTOURS REPRESENT MAXIMUM DETECTED VOC CONCENTRATION AT EACH SAMPLE LOCATION.

LEGEND

- ▲ GEOPROBE SAMPLE LOCATION
- ⊙ RECOVERY WELL LOCATION
- ◆ PIEZOMETER LOCATION
- ⊕ GROUND WATER MONITORING WELL LOCATION
- – – – VOCs CONCENTRATION CONTOUR
- ▨ FREE PHASE LNAPL LAYER

MONSANTO COMPANY
JOHN F. QUEENY PLANT
LNAPL SUBSURFACE INVESTIGATION
ESTIMATED CONCENTRATION CONTOURS FOR VOCs IN GROUND WATER

1" = 200'-0"

FILE NO. 2600.025-03F

OBRIEN & GERE ENGINEERS, INC.